Psychology of Sport & Exercise 80 (2025) 102918

Contents lists available at ScienceDirect

Psychology of Sport & Exercise

journal homepage: www.elsevier.com/locate/psychsport

Health behaviour change: Theories, progress, and recommendations for the next generation of physical activity research

Aaron Simpson [a,b,*], Mark R. Beauchamp [c], James Dimmock [b,d], Claire Willis [a,b], Ben Jackson [a,b]

[a] School of Human Sciences (Exercise and Sport Science), The University of Western Australia, Perth, Australia
[b] The Kids Research Institute Australia, Perth, Australia
[c] School of Kinesiology, The University of British Columbia, Vancouver, BC, Canada
[d] Department of Psychology, College of Healthcare Science, James Cook University, Townsville, Australia

ARTICLE INFO

Keywords:
Behavior change
Behavior maintenance
Co-design
Exercise
Health promotion
Sport
Trial design

ABSTRACT

Adaptive behaviour change is central to improving population health, yet poor adoption of health-enhancing behaviours contributes to noncommunicable diseases and so remains a global concern. Research on physical activity behaviour change has continued to expand and evolve since the turn of the millennium, guided by diverse theoretical approaches—from social cognitive theories, organismic dialectical approaches such as Self-Determination Theory, dual-process frameworks, and integrated practical models and taxonomies. Key challenges and opportunities remain, however, and in this paper we offer several calls to action for those working to advance physical activity behaviour change theory, research, and practice. First, we advocate for more precise examination of behaviour *change* itself, moving beyond static models to incorporate dynamic theories and methodologies (including data analysis) that better capture how behaviours evolve and change over time. Second, we emphasise the need to prioritise behaviour maintenance, recognising that many interventions succeed in initiating change but fail to support long-term adherence. Third, we call for a concerted effort to broaden our target populations in behaviour change research, ensuring that interventions (and the theories that inform them) are more inclusive, widely applicable, contextually relevant, and equitable. Finally, we highlight the growing recognition of automatic processes in shaping physical activity behaviours and outline the importance of refining measurement tools and intervention strategies to account for these non-conscious influences. These considerations are articulated with a view to supporting the next generation of physical activity behaviour change research and practice, and in doing so contribute to improved population health equity and outcomes.

Understanding human behaviour, and how we might support *change* in that behaviour, is a deeply entrenched research pursuit—spanning, for example, social (Davis et al., 2015), political (Leggett, 2014), environmental and economic sciences (Barr et al., 2011; Muranko et al., 2019), and public health (Free et al., 2013; West et al., 2020). In the 25 years since *Psychology of Sport and Exercise's* (*PSE*) first publication, the 'science' of behaviour change has been applied to diverse health issues ranging from smoking cessation (Shoesmith et al., 2021), to alcohol and substance misuse treatment (Howlett et al., 2022), to vaccine uptake (Ekezie et al., 2023), to sexual health (Wellings et al., 2006), to diet (Samdal et al., 2017), and physical activity (Rhodes, McEwan, & Rebar, 2019). Despite this work, noncommunicable diseases continue to represent a critical global health concern (Shu & Jin, 2023), driven by widespread health-compromising and insufficient health-enhancing behaviours (World Health Organization, 2022). As such, supporting individuals to improve their health behaviour is as important now as it has ever been (Nielsen et al., 2018).

Efforts to address noncommunicable disease through health behaviour change is a well-established priority for researchers, policymakers, and funders (e.g., Hagger, Moyers et al., 2020; Johnson & Acabchuk, 2018). Indeed, behaviour change research featured in the very first volume of *PSE* some 25 years ago (see Courneya & Bobick, 2000; Gorely & Bruce, 2000). And, since the turn of the century, there has been a noticeable proliferation of research focused on health behaviour change.

This article is part of a special issue entitled: PSE 25th Anniversary published in Psychology of Sport & Exercise.

* Corresponding author. School of Human Sciences, University of Western Australia (M408), 35 Stirling Highway, Crawley, Western Australia 6009, Australia.
E-mail address: Aaron.Simpson@uwa.edu.au (A. Simpson).

https://doi.org/10.1016/j.psychsport.2025.102918
Received 19 February 2025; Received in revised form 10 June 2025; Accepted 11 June 2025
Available online 11 June 2025

To illustrate this growth, a simple *Google Scholar* search of "behaviour change" and "health" (which we recognise represent rudimentary search terms) returns approximately 1700 results for research published in the year 2000, approximately 7000 results for 2010, and close to 25,000 results for 2024. With this burgeoning literature as a backdrop, we reflect in this article on the developments we have seen in behaviour change research accompanying *PSE's* rich 25-year history, and also offer what we consider to be key 'calls to action' for researchers and practitioners working in this diverse field. Given that work featured in *PSE* focuses on a specific form of health behaviour (i.e., physical activity), and given the complexity of different types of health-enhancing (e.g., physical activity) versus health-compromising (e.g., smoking) behaviours, we focus our coverage primarily on physical activity (inclusive of sport and exercise). However, where our coverage benefits from reaching beyond *PSE's* sphere, we draw from other health and psychological domains.

The benefits of physical activity are widely recognised—nonetheless, a large proportion of the population remains insufficiently active (Guthold et al., 2018), presenting a substantial global health and economic burden (Costa Santos et al., 2023). The idiosyncrasies of changing physical activity compared with other health-affecting behaviours were aptly described by Rhodes and Nigg (2011), whereby physical activity must be adopted (as opposed to ceased), requires considerable and sustained time and effort, and consists of an adaptive physiological response. It is no surprise, therefore, given both the benefits and challenges inherent in pursuing regular physical activity, that physical activity behaviour change (and understanding physical activity behaviour more broadly) has received sustained research attention for over 30 years (see Rhodes, McEwan, & Rebar, 2019; for a comprehensive overview). Select theories (or theoretical approaches) have dominated the behaviour change literature (see Davis et al., 2015; Michie et al., 2014), including work that is focused specifically on physical activity (Rhodes, Boudreau et al., 2021). That is not to say, however, that work outside of these theories has not contributed to progression the field—in fact, *PSE* has long been a leader in promoting diverse approaches (across quantitative and qualitative literature) to understanding behaviour (e.g., Camiré, 2023; McGannon & Schinke, 2013; Smith & Sparkes, 2009). Below, we briefly overview broad types of behaviour (change) theories, and in doing so align with Davis et al.'s (2015, p. 327) definition of theory as "a set of concepts and/or statements with specification of how phenomena relate to each other". In addition to considering theory, we also devote attention to some of the frameworks that more directly identify mechanisms of action that influence behaviour change.

1. Looking back: prominent theories of health behaviour and behaviour change

Health behaviour is driven by a complex interplay of psychological, social, and environmental determinants. This notion has been extensively explored through a socioecological lens stemming from Bronfenbrenner's (1977, 1979) seminal work (see Hagger, 2025). Given the focus of work featured in *PSE*, we limit our discussion largely to those theories and frameworks that are broadly considered psychological in nature. We also recognise that comprehensive reviews of these theories and other contributors to physical activity behaviour change are available in the literature (e.g., Hagger, 2025; Rhodes, McEwan, & Rebar, 2019); as such, we provide relatively brief coverage and direct interested readers to more detailed reviews where appropriate. Much of the work on physical activity behaviour has traditionally been dominated by select theories—Theory of Planned Behaviour, Social Cognitive Theory, Self-Determination Theory, and the Transtheoretical Model (Biddle et al., 2023; Davis et al., 2015; Gourlan et al., 2016; Rhodes, McEwan, & Rebar, 2019). More recently, we have seen additional theoretical approaches (e.g., dual-process theories) applied to the study of physical activity behaviour change, and the development of practical frameworks designed to guide behaviour change interventions.

Many of the theories that have dominated the last 25 years of physical activity behaviour research are rooted in social cognitive principles (Rhodes, McEwan, & Rebar, 2019). The prominence of these theories stems from the notion that social cognitive variables (e.g., beliefs and intentions) are the most proximal and modifiable factors influencing behaviour (Conner & Norman, 2015). These theories are underpinned by the premise that people act (at least in part) according to expectancies and values of behavioural outcomes, typically comprising perceived control of behaviour and intentions or expectations (Armitage & Conner, 2000). In essence, social cognitive approaches to physical activity behaviour assert that "individuals will intend to be physically active if they believe that (a) physical activity is important, and (b) they are truly capable of enacting activity" (Rhodes, McEwan, & Rebar, 2019, p. 101). To illustrate, the Theory of Planned Behaviour (Ajzen, 1991) is a widely-adopted theory that uses a social cognitive approach to explain and predict behaviour. A core premise of the Theory of Planned Behaviour is that intention is the primary driver of behaviour, and that attitudes, subjective norms (beliefs about social pressure or expectations), and perceived control of the behaviour contribute to intentions (Ajzen, 2020). Further, the degree of *actual control* over the behaviour moderates the effect of intention on behaviour. Despite criticism over time (Sniehotta et al., 2014), the Theory of Planned Behaviour has influenced many other theories of behaviour (see Michie et al., 2014) and consists of constructs embedded within, or related to, other prominent theories, such as Social Cognitive Theory (Bandura, 1986; see Beauchamp et al., 2019 for a comprehensive overview in its application to physical activity). There is evidence, for example, that perceived behavioural control is highly correlated with self-efficacy (yet they remain conceptually distinct, and predict behaviour differently depending on experience engaging in that behaviour; Parkinson et al., 2017). Although these theories remain popular for at least partially explaining people's behaviours, one criticism of many social cognitive approaches is the overemphasis on the individual as the primary driver of behaviour change, and the lack of attention paid to environmental (or external) influences, and/or automatic, non-conscious behavioural processes (Rhodes, McEwan, & Rebar, 2019).

Beyond social cognitive theories, a substantial body of work in the physical activity behaviour domain (and indeed many other domains) has been underpinned by Self-Determination Theory (Deci & Ryan, 1985, 2000; see Ryan & Deci, 2024, for a recent and brief overview). In fact, Self-Determination Theory is likely *the* most commonly applied theory in relation to physical activity and exercise psychology research over the past 25 years (Brand & Ekkekakis, 2021). Self-Determination Theory is a broad organismic dialectical theory of human motivation, behaviour, and wellbeing, comprised of six mini-theories that outline the underlying conditions that promote motivated behaviour (Hagger, Hankonen et al., 2020; Ryan & Deci, 2019). It is beyond our scope to describe these mini-theories in detail (instead, see Ryan, 2023); however, two in particular have been frequently explored in physical activity contexts; these correspond to Basic Psychological Needs Theory and Organismic Integration Theory (Rhodes, McEwan, & Rebar, 2019). Organismic Integration Theory delineates differences between *types* of extrinsic motivation—from controlled external pressure (e.g., to avoid punishment), to more autonomous forms of motivation (e.g., pursuit of activities that are integrated with one's values; Ryan & Deci, 2019). In addition to explicating extrinsic motivation, Organismic Integration Theory depicts motivation on a continuum from amotivation (i.e., a complete lack of drive to engage in a behaviour), through extrinsic motivation, to intrinsic motivation (i.e., engaging in a behaviour because it is inherently enjoyable). Basic Psychological Needs Theory is centred on the notion that humans have three universal psychological needs—autonomy, relatedness, and competence—that affect wellbeing depending on the degree to which they are satisfied or thwarted (Vansteenkiste et al., 2023). From a behaviour change (and maintenance, which we explore later) perspective, the focus of

Self-Determination Theory on the *quality* of motivation for a behaviour (as opposed to just quantity) is unique in comparison to other theoretical frameworks (Teixeira et al., 2020). There is ample evidence supporting the notion that, if environments are structured such that one's psychological needs are satisfied, those individuals will experience a higher *quality* of motivation (i.e., more autonomous motivation) for pursuing physical activity, and, therefore, will be more physically active (Ntoumanis et al., 2021; Ryan et al., 2022; Sheeran et al., 2020). Positive effects of need support have also been widely reported in the sport-based psychology literature (e.g., Mossman et al., 2024; see Ryan et al., 2022 for a meta-review of Self-Determination Theory research).

The above theories focus predominantly on conscious, deliberate evaluations of a behaviour or stimulus. Dual-process frameworks, which have received increased attention in health and physical activity research in recent years (and for even longer in cognitive psychology; e.g., Smith & DeCoster, 2000), offer a different perspective to the reasons for someone engaging in a behaviour. At the time of *PSE's* emergence at the turn of the century, scientific articles on dual-process frameworks in physical activity were scarce. A *Google Scholar* search of "dual-process" and "physical activity" reveals only 38 articles published in 2000, compared to more than 800 published in 2024 (perhaps attributable, in part, to increased scholarly and public interest following the widespread commercial success of Daniel Kahneman's 2011 classic text, *Thinking, Fast and Slow*).[1] The rise in interest in dual-process models has also been driven by evidence that intention accounts for only *some* of the variance in behaviour (and even less in *change* in behaviour; Feil et al., 2023; McEachan et al., 2011; Rhodes & de Bruijn, 2013). Dual-process frameworks are labelled as such due to their inclusion of fast, automatic, 'non-conscious' processes that influence behaviour alongside more reflective, conscious processes (Rhodes, McEwan, & Rebar, 2019).[2] These non-conscious processes are purported to act as an efficient 'default' driver of behaviour unless people have the motivation and capacity to modify their behaviour (Evans & Stanovich, 2013; Wood & Rünger, 2016). Consequently, self-regulation (i.e., one's ability to manage, control, or adapt behaviours, emotions, and response tendencies to achieve future desired goals; see Englert & Taylor, 2021; Hennessy et al., 2020) is often considered within dual-process frameworks (Houlihan, 2018). Similarly, contemporary physical activity behaviour change theories, such as Affective-Reflective Theory (Brand & Ekkekakis, 2018), incorporate both automatic (affective) valuations of a behaviour and deliberate (reflective; self-control-driven) evaluations of stimuli to exercise (see Brand & Ekkekakis, 2021).

Within dual-process frameworks, a range of non-conscious processes are posited to influence behaviour. For example, automatic evaluations refer to one's rapid, automatic association between a stimulus (e.g., physical activity) and feelings of favourability or unfavourability (e.g., pleasant or unpleasant; Rebar et al., 2016; Zenko & Ekkekakis, 2019); and habits represent impulses to act, based on associations between a cue (e.g., time of day) and a behaviour learned through repetition of the behaviour in the presence of the cue (Gardner et al., 2024). There is growing evidence regarding the influence of non-conscious processes on physical activity behaviour (Rebar et al., 2016)—particularly with respect to habits (Rhodes, McEwan, & Rebar, 2019). Habits have been shown to predict physical activity behaviour independent of intentions, and may partially mediate the relationship between past and future behaviour (Hagger et al., 2023). Our understanding of habits is evolving rapidly; recent developments include temporal influences of preparation and initiation phases of habits (Hardwick et al., 2019), the role of the complexity of behaviour (Phillips & Mullan, 2023), and interactions with self-control (Gardner et al., 2020).

Many of the above theoretical frameworks address specific determinants of behaviour; for example, social cognitive theories are primarily concerned with beliefs and cognitions (Conner & Norman, 2015). And, although this body of work has proved valuable for understanding why people may undertake (or avoid) certain health behaviours, these theories often do not provide targeted, practical guidance for researchers and practitioners as to how they can best help people *change* (i.e., increase, decrease, initiate, or cease) their behaviour. At times during the last 25 years, we have seen well-articulated calls for an applied science that is focused more explicitly on the process of '*change*' within the broader health behaviour literature (e.g., Aunger & Curtis, 2016; Sheeran et al., 2017). Fortunately, a number of theory-informed frameworks have emerged and been tested that focus on identifying the factors or strategies that elicit behaviour *change* within interventions. These frameworks have been described as 'meso-level' theoretical approaches, with a strong theoretical evidence base, but designed to assist health promoters in implementing behaviour change (Rhodes, McEwan, & Rebar, 2019).

One example of an approach designed to capture multiple elements of behaviour *change* (and specifically to address the 'gap' between intentions and behaviour), is the multi-process action control (M-PAC) framework (Rhodes, La et al., 2021). The M-PAC has been referred to as a 'meta-construction' of multiple traditions of behaviour research, and thus integrates reflective, regulatory, and reflexive mechanisms (discussed above) together in a hierarchical, causal, and interrelated structure with implications for intentions and translating those intentions into action (i.e., action control; Rhodes, 2017, 2021). To add practical value, Rhodes (2017) also included a description of behaviour change *techniques* (see below) that have the capacity to influence these reflective, regulatory, and reflexive processes in adopting and maintaining behaviour. Overall, the M-PAC approach provides insight into the factors most likely to affect (a) *reflective processes* that help people establish behavioural intentions, (b) *regulatory processes* that support the adoption of a behaviour, and (c) *reflexive processes* that engender sustained action control (e.g., physical activity engagement and maintenance; Rhodes, 2021). There is evidence to support the notion that each component of the M-PAC framework predicts variance in physical activity behaviour (Porter et al., 2024), and that M-PAC constructs are changeable over time and may lead to changes in physical activity (see Rhodes, La et al., 2021).

In a similar vein, the Behaviour Change Wheel (Michie et al., 2011) provides both a model of behaviour change and guidance for intervention design. The causal, explanatory aspect of the Behaviour Change Wheel is that, for a behaviour to occur, it is necessary for one to have sufficient *capability* (physical and psychological), *opportunity* (social and physical), and *motivation* (automatic and reflective). Additionally, it is proposed that capability and opportunity can shape motivation, and that behaviour has a bi-directional relationship with all three proposed antecedents (labelled together as the COM-B model; Michie et al., 2011). The COM-B model underpins the practicality of the Behaviour Change Wheel, whereby specific intervention functions (e.g., education, incentivisation) are linked to target constructs (capability, opportunity, motivation) that are most valuable for stimulating behaviour change in any given context. The Behaviour Change Wheel is also designed to align with other models (such as the Theoretical Domains Framework; Atkins et al., 2017; Cane et al., 2012; Mather et al., 2022), and is supported with well-established taxonomies and ontologies detailing specific *behaviour change techniques* (Marques et al., 2024; Michie et al., 2013). These frameworks, perhaps most prominently the Behaviour Change Technique Taxonomy (Abraham & Michie, 2008; Michie et al., 2013, 2015),

[1] Despite initial widespread acclaim and undoubted influence on the increase in interest in dual-process frameworks, *Thinking, Fast and Slow* has also received some notable criticism, including from Kahneman himself (for example, see https://replicationindex.com/2020/12/30/a-meta-scientific-perspective-on-thinking-fast-and-slow/).

[2] Although the term 'dual-process' implies that processing features exist in one of two possible 'systems' (reflective or non-conscious), some cognitive scientists have noted that this typology may be flawed and, instead, psychological processes likely involve a combination of reflection and automation (see Melnikoff & Bargh, 2018).

establish a common language and 'toolkit' for intervention content and methods, and have become widely used in behaviour change research (Carey et al., 2019; interested readers may also visit www.humanbehaviourchange.org, for practical resources and information on recent advancements). The Behaviour Change Technique Taxonomy aligns with Rhodes, McEwan, and Rebar's (2019) description of a 'meso-level' approach, presenting theoretically underpinned *techniques* with the aim of helping intervention designers target and be intentional in changing people's behaviours (Michie et al., 2021). These techniques include, for example, goal-setting, self-monitoring, prompts, and verbal persuasion about capability (Michie et al., 2013), with evidence supporting the effectiveness of many of these techniques in changing physical activity behaviour (e.g., Samdal et al., 2017). Some researchers have criticised these large-scale, prescriptive frameworks for reducing variability in practice (Ogden, 2016) and restricting attention paid to nuances in individuals' context and behaviours (Walsh & Foster, 2021). Ogden (2016), in their criticism of systemisation, questioned whether integration of behaviour change theories within a single structure 'solves' problems, noting the potential consequences for scientific creativity and independence when ideas become invariable and accepted as truths beyond critique. Nonetheless, these frameworks are valuable for achieving replicability, aiding consistency in reporting, and identifying effective (and ineffective) intervention 'ingredients'. In doing so, these frameworks have substantively advanced our collective ability to connect theory and practice through an improved understanding of specific behaviour change mechanisms (Schenk et al., 2024).

2. Looking forward: advancing the science and practice of physical activity behaviour change

Having looked back at key trends in the physical activity behaviour change literature, we turn our attention now to looking forward. In doing so, we present a series of 'calls to action' for researchers and practitioners working in this area—reflecting on new approaches, emerging ideas, and overlooked questions regarding behaviour change theory and methods. We ground these recommendations in recent commentary within our field (e.g., Rhodes, McEwan, & Rebar, 2019) as well as developments in other related areas (e.g., social psychology, clinical trial design). Taken together, we hope these calls to action will contribute to continued development of our understanding and application of physical activity behaviour change.

2.1. Spotlighting the change in behaviour change

Our understanding of behaviour in a general sense is often not separated from the more specific issue of what it takes to *change* a particular behaviour. Behavioural theories help explain or predict why a behaviour may or may not occur. Questions of behaviour *change*, though, are more closely focused on the dynamic processes influencing how a behaviour begins, ends, increases, or decreases over time (Davis et al., 2015). Understanding the determinants of behaviour in a general sense is of course central to understanding how best to design and deliver targeted behaviour change interventions (Hagger, 2025). The Theory of Planned Behaviour, for example, is not a theory of behaviour *change* (Ajzen, 2015), but has been used widely in behaviour change interventions (Davis et al., 2015; Hardeman et al., 2002). Importantly though, the degree to which a psychological construct (e.g., intention) predicts health behaviour may not necessarily be mirrored by the degree of *change* that results in a specific health behaviour when targeting that construct (Sheeran et al., 2017). We believe the field of physical activity behaviour change research would be meaningfully progressed by considering the precision with which we think about *changing* behaviour—and importantly, by adopting dynamic theories and innovative research methods (and analytic approaches) that allow us to more precisely study, measure, and manipulate change.

As outlined earlier, much of the work on physical activity behaviour change has been based on a handful of theories—many of these theories are 'static' in that they do not seek to predict changes over time or account for non-linear processes (Michie et al., 2014). As Ajzen (2015) highlighted, for instance, many theories and models are typically not investigated or applied in such a way as to examine feedback loops. Historically, cross-sectional and prospective correlational designs have often been used to identify variables that correlate with physical activity behaviour (see Bauman et al., 2012, for a review of literature exploring correlates of physical activity). This approach has given insight into the demographic, environmental, psychosocial, and behavioural factors associated with physical activity; however, it does not account for the complexity, nonlinearity, and dynamicity of human behaviour (Heino et al., 2021). To better understand the psychological processes that influence how physical activity behaviour changes over time, we encourage the adoption of dynamic models, study designs, and analyses. There is merit, for instance, in greater application of dynamic conceptual frameworks for physical activity behaviour. As an example, Garcia et al. (2017) presented a dynamic model of behaviour from a social cognitive perspective that explicitly outlined the reciprocal relationship between behaviour, the social environment, and intentions. Similarly, complex dynamic systems (see Hofmann et al., 2020; Uleman et al., 2024) are another approach that would better represent how multiple causal networks interact and influence the individual processes related to behaviour change. Uleman and colleagues (2024), for instance, reported 36 causal links in the trajectory of depressive symptoms in response to a stressor, with interplay between variables such as sleep disturbance, prosocial behaviour, and loneliness. Exploring and developing causal networks in physical activity research (e.g., in the course of sport participation after injury) would enable researchers to target specific causal pathways upon which they could intervene.

We can also better model and induce change through the way we approach study design. Intensive longitudinal methods (typically involving regular, repeated, real-time, and 'real-world' data collection) offer the ability to explore research questions such as "what within-person process underlies a person's changes, and how do people differ in this process?" (Iida et al., 2023, p. 329). Such designs also allow for a more accurate reflection of behaviours in the natural setting in which they occur (Harari & Gosling, 2023; see Perski et al., 2022, for a recent review of these designs in the study of health behaviours). Recent technological advancements are making intensive longitudinal data collection more accessible and informative (Dunton, 2017). For instance, sensors on smartphones allow us to gather information on temporal, physical, spatial, behavioural, digital, and social contexts while someone is engaging in physical activity (Harari & Gosling, 2023). Access to data of this nature can guide researchers as to when, how, and how much to intervene to have the largest effect on behaviour change. Intensive longitudinal methods also permit more dynamic modelling approaches to data analysis. Ruissen, Zumbo, and colleagues (2022), for example, highlight statistical approaches (e.g., dynamic structural equation modelling; Asparouhov et al., 2018) used more frequently in other fields that could be applied to physical activity research (although, see Ruissen, Beauchamp, et al., 2022, for an example in the physical activity domain). When used to analyse intensive longitudinal data, such dynamic approaches could provide insight into physical activity persistence over time depending on changes in another variable that can be measured repeatedly (e.g., affect, intention).

Just-in-time adaptive interventions (JITAIs) are another relatively recent development in intervention design that take advantage of data derived from improved technological capabilities (and dynamic models of behaviour; Spruijt-Metz & Nilsen, 2014). JITAIs allow the delivery of adapted, tailored support to participants depending on their context and internal state, typically monitored through wearable and mobile devices (Nahum-Shani et al., 2018). In doing so, participants can receive an intervention when they are likely to be most receptive (e.g., based on time of day, weather, affect, or current activity; Nahum-Shani et al., 2018). And, through ongoing developments in artificial intelligence (AI)

and machine learning, participants can receive interventions that are highly personalised (Vandelanotte et al., 2023). There is promising preliminary evidence supporting the use of JITAIs in changing physical activity (Hardeman et al., 2019) and other health (Wang & Miller, 2020) behaviours; however, there is a need for larger scale effectiveness trials (Willms et al., 2024) and integration with dynamic theories of behaviour (Nahum-Shani et al., 2018). Interestingly, with a growing evidence-base for the effectiveness and noninferiority of AI-based chatbots (relative to human interaction) within traditional cognitive behavioural therapy (Kuhail et al., 2024; Zhong et al., 2024), the use of such chatbots within JITAIs (as proposed by Vandelanotte et al., 2023) could play an important role in how we design and deliver a new generation of physical activity behaviour change interventions. AI chatbot-based interventions have begun to appear in the physical activity field with mixed evidence (Yang et al., 2025). Nonetheless, as the quality of the technology continues to improve, these tools have the potential to deliver on-demand, personalised, engaging support to promote change in physical activity behaviour beyond the capacity of human-led support. Further work is required to establish best-practice JITAI development and implementation.

In terms of trial design, it is also worth noting the potential of adaptive platform trials as an innovative way with which we could study and manipulate physical activity behaviour change. Typically applied to date in clinical (e.g., healthcare, hospital) settings, adaptive platform trials allow for the investigation of *multiple interventions simultaneously and in perpetuity*, under a single trial architecture (Angus et al., 2019). Importantly, the *adaptive* element of the design lies within the incorporation of within-trial adaptations—rules derived from algorithms that, for example, inform whether an intervention should be modified, added to, or removed from the trial, or whether randomisation or allocation ratios are amended based on interim analyses (Angus et al., 2019; Koenig et al., 2024). Such an approach offers greater efficiency in research, fewer participants randomised to interventions that turn out to be inferior, and ongoing intervention quality improvement (see Angus et al., 2019, for an overview of considerations for conducting adaptive platform trials; see also Griessbach et al., 2024; Koenig et al., 2024).

Adaptive platform trials are, to date, largely absent from the physical activity behaviour change literature. However, these designs (and modified alternatives; e.g., see Blackwell et al., 2023, for a description of 'leapfrog' trials) may significantly progress our study of physical activity behaviour change. As an example, researchers interested in the effectiveness of goal setting processes for exercise adoption may randomise participants to various interventions utilising different (or different combinations of) goal setting characteristics (e.g., source—self-set versus collaboratively-set versus assigned by others; specificity—open versus specific goals). As the trial progresses, interim analyses allow researchers to explore which interventions are leading to more promising results, determining whether some interventions (or components within interventions) are halted, added, or modified (e.g., an increased dose, different mode of delivery, or additional 'technique' components included). These analyses also guide how participants continue to be randomised (i.e., preferential allocation to more effective interventions). In our hypothetical example, it is conceivable that an assigned goals condition (where researchers give exercisers a goal to achieve without consultation) leads to poorer motivational outcomes, reaching an intervention end-point of a pre-defined decision algorithm. This intervention would (or could) then be ceased, and a new intervention component added. Similarly, in our hypothetical example, promising findings might point to improvements in motivational processes among participants within a collaborative goals condition, but no increase in actual exercise engagement. In such an instance, the research team could, therefore, choose to modify this intervention by adding, for example, a self-monitoring component. The trial would continue to run, with ongoing alterations made to specific interventions depending on the decision algorithm.

Due to the fast pace with which interventions can be developed and tested, and the ease with which intervention components can potentially be modified (e.g., dose, behaviour change techniques), adaptive platform trials also hold promise for the design of physical activity interventions for mental and physical health conditions (Blackwell et al., 2023; Schmitz et al., 2025). Further, the use of technology to collect data (as discussed above) integrates well with adaptive platform trial designs, in that these measurement methods allow for (within trial designs that rely on) rapid, frequent insight into the effectiveness of (and engagement with) each intervention in the trial. The use of adaptive platform trial design(s) is not without its challenges—for instance, the substantial upfront time and funding investment required, and statistical and logistical complexity (Angus et al., 2019; Gold et al., 2022). Nonetheless, this trial architecture holds substantial potential for stimulating a new generation of physical activity behaviour change research.

2.2. *After the party is over: studying maintenance of physical activity behaviours*

In their meta-analysis, McEwan and colleagues (2022) reported empirical evidence illustrating the challenge that physical activity researchers have recognised for decades (Marcus et al., 2000); that although behaviour change interventions (i.e., the 'party', in their metaphor) may improve (or *change*) physical activity in the short term, these changes are difficult to maintain over time (i.e., after the 'party' is over). In terms of proposed causal influences, most of the prominent theories that are used in our field do not delineate the *maintenance* of behaviour from its initial adoption (Rhodes & Sui, 2021). Traditionally, maintenance of physical activity has often been viewed through the lens of an arbitrary time, frequency, and/or consistency threshold (Dunton et al., 2022). There are, however, differences in the proposed theoretical underpinnings of behaviour *change* and behaviour *maintenance* (Kwasnicka et al., 2016). Rhodes and Sui (2021), for instance, described maintenance as a process whereby the mechanisms of action determining physical activity behaviour differ markedly from the mechanisms of action required to first *initiate* behaviour. Rhodes and Sui (2021) used the example that although task self-efficacy may be closely tied to the initiation of physical activity, it may have little mechanistic influence on the maintenance of physical activity (and instead, constructs like habit or identity may be more salient). Dunton and colleagues (2022) also presented a novel conceptualisation of physical activity maintenance, highlighting five key 'inflection points' in the trajectory of physical activity behaviour—initiation, adoption success, maintenance success, maintenance vulnerability, and maintenance failure. In light of evidence pointing to the unique challenges and mechanisms involved in maintaining, and not just changing, physical activity (McEwan et al., 2022), it is important that we approach each of these behavioural stages in a systematic and targeted way.

At the most fundamental level, we should seek opportunities to extend our data collection windows to establish and test moderators of maintenance outcomes (Whatnall et al., 2021). Beyond this, or as part of such an effort, intensive longitudinal methods (and accompanying data analysis approaches) also provide a way that we could not only expand our understanding of within- and between-person variations in behaviour maintenance, but also shed light on the features of each phase of maintenance proposed by Dunton et al. (2022). For example, maintenance vulnerability—characterised by a reduction in physical activity beyond that considered to be a 'natural' fluctuation—could be identified (and potentially remediated) before one reaches a further point of maintenance failure. Indeed, by identifying maintenance-related vulnerabilities earlier and with more precision, we may be able to better tailor our intervention efforts (e.g., in a JITAI delivered through a mobile app, targeted prompts). Repeated assessment of behaviour change and maintenance mechanisms (e.g., outcome expectancies, self-determined motivation, habits) would also allow us to better model at what point in the maintenance stage each mechanism is most influential as a predictor of continued, discontinued, and/or fluctuations in

behaviour.

As noted above, many behaviour change theories do not separately define maintenance or delineate it from change (Rhodes & Sui, 2021); there are exceptions, however, that do explicitly consider a maintenance stage and an associated set of maintenance-related processes or predictors. The constructs in these frameworks are useful for informing more targeted study and support for physical activity maintenance. The M-PAC framework (Rhodes, 2021), for example, proposes that adoption of (i.e., initial change in) a behaviour occurs through regulation processes, but that behaviours are maintained through the establishment of reflexive processes (identity and habit). Similarly, the health action process approach model (HAPA; Schwarzer, 2008) considers the constructs involved in maintenance (e.g., coping self-efficacy) separately to those involved in forming intentions to begin a behaviour. Despite such theorising related to the distinct psychological processes involved in adoption versus maintenance, it is noteworthy that sustained empirical investigation into maintenance mechanisms is lacking (Zhang et al., 2019). With this in mind, theoretical frameworks like the M-PAC or HAPA offer a promising jumping-off point for increased attention regarding the constructs that help turn behaviour change into successful behaviour maintenance.

Adaptive study designs, such as adaptive platform trials described above, are also (to date) an under-utilised method for investigating behaviour maintenance. Adaptive platform trials, for example, would allow for the cessation, development, or modification of interventions (and intervention arms) over time depending on their effectiveness in promoting maintenance of physical activity. In a similar vein, sequential multiple assignment randomisation trials (SMARTs), as an example of another line of work in the broader field of adaptive interventions, are multistage trials in which participants are randomised at defined, multiple decision points (Kidwell & Almirall, 2023). The value of such trial designs is increasingly being recognised in physical activity research (see Whiston et al., 2024, for a review of how they have been used). To briefly illustrate how a SMART design may be used to explore physical activity behaviour maintenance, one might consider a trial designed to sustain exercise engagement for people who have recently experienced a cardiac event. Participants, in such an instance, may initially be provided with supervised (i.e., in clinic) exercise for their first three months post-cardiac event, and at three month post-event are encouraged to maintain exercise in their own time—with randomisation to either intervention arm A (e.g., an app that facilitates self-monitoring of exercise progress) or intervention arm B (e.g., an app that facilitates social connection with other cardiac rehabilitation patients) to assess the relative effectiveness of these approaches in supporting cardiac rehabilitation patients' exercise maintenance. Data on behaviour and engagement with the intervention, as well as on mechanisms of interest (e.g., self-regulatory efficacy, outcome expectancies), could be collected at regular intervals from the beginning of the trial. And, at the first 'decision point' (for example, 6 months post-event), participants who had maintained their exercise behaviours may continue with their maintenance intervention, whilst those who had not responded to the intervention (i.e., low engagement, or reduced exercise behaviours) would be re-randomised into intervention arms that provide additional or alternative support (intervention conditions C and D). Data collection, in this example, would then continue for all participants, helping to identify interventions, behaviour change techniques, and psychological constructs that may support long-term maintenance of behaviour. The example above also allows for the exploration of whether certain sequences of interventions (e.g., first receiving intervention A, and then intervention C) most effectively facilitate maintenance of physical activity. Importantly, as we look to the next generation of behaviour change (and maintenance) science, these more adaptive or responsive study designs will be aided by drawing from models that explicitly inform us about maintenance processes (e.g., Dunton et al., 2022).

2.3. Broadening a literature that is predominantly 'WEIRD'

In the 2010 volume of *Behavioral and Brain Sciences*, Henrich and colleagues spotlighted our overreliance on Western, Educated, Industrialised, Rich, and Democratic (WEIRD) populations within psychological and behavioural sciences. Their article, one of the most consequential psychology papers published during *PSE's* 25-year existence, has been cited more than 16000 times (*Google Scholar*) and drew attention to the problems of generalising psychological findings and theories developed from WEIRD (and most often American) samples. Diversity (or a lack thereof) in sampling is as pertinent today as it was in 2010 and the decades prior (Alcántara et al., 2020; Apicella et al., 2020)—and, although this challenge exists across the psychological and behavioural sciences (and its various subdisciplines), it warrants comment here specifically with respect to physical activity behaviour change. Given the maturity of contemporary physical activity behaviour change research, it is incumbent that we now target greater sociodemographic, contextual, and cultural diversity in our work.

We encourage researchers working in this area to broaden the boundaries of what is known about, and the populations involved in, behaviour change (Chalabaev et al., 2023), and to consciously consider the intersectionality that is inherent in such work. More concerted efforts to adopt (and promote) non-WEIRD ways of living and thinking is needed (see Li et al., 2025, for recent work adopting an Eastern philosophical perspective for a non-WEIRD population, instead of a Western perspective). Attempts to conduct research appropriately within its social context should include reflexivity—consideration of one's own positionality—as a crucial methodological process (Clancy & Davis, 2019). Indeed, in writing this call to action, we recognise our own position as researchers from WEIRD contexts, and its influence on our ability to truly recognise what is necessary for advancing health behaviour change in non-WEIRD settings. Researchers should also examine how unique and important factors influencing behaviour change emerge when viewed through population, societal, and cultural perspectives (see Etherington et al., 2020; Heard et al., 2020). Framing research within a multilevel, socioecological perspective (Bronfenbrenner, 1977)—and directing concerted effort to working with marginalised, diverse, and underserved (i.e., non-WEIRD) populations—will expand our understanding of the above factors, and identify novel strategies to address population and geographic divergence in behaviour change processes (Hagger, 2025). There is a need to adopt research methodologies in consideration of cultural praxis—McGannon and Smith (2015), for instance, highlight narrative inquiry and discursive psychology as two qualitative methodologies researchers might use in pursuing a nuanced understanding of the intersection of theory and lived culture. Additionally, cultural adaptation within health behaviour change interventions *is* increasing in prevalence and is generally effective in improving health outcomes (Barrera et al., 2013; Fischer et al., 2024). Fewer examples exist, however, within physical activity settings (see Murray et al., 2017, for one). And, where collaborative approaches such as 'citizen science' are proliferating in health and physical activity research, the majority of studies have not focused on intervention development with underserved or diverse populations (Marks et al., 2022).

The importance of participatory approaches (e.g., co-design) in designing interventions *with*—instead of *for*—populations is becoming more apparent (Grindell et al., 2022), particularly when aiming to facilitate behaviour change in marginalised and 'diverse' populations (Khan et al., 2024). Co-design is a broad methodology that places researchers and community members in partnership with the goal of identifying needs, promoting trust, and empowering the voices of the intended recipients of an intervention (Grindell et al., 2022). Principles and techniques embedded within co-design (see Constantin et al., 2022; Kilfoy et al., 2024, for recent reviews on methods) will improve our collective ability to make meaning for, and tailor work to, the populations that have traditionally received the least attention in our field.

Most importantly, in a practical sense, more consistent use of co-design practices with non-WEIRD populations will also generate more acceptable, appropriate interventions for these groups, fostering engagement with interventions (and, potentially, substantively improving outcomes for those in need of support; Grindell et al., 2022). In addition, such efforts may also advance our knowledge of population- and/or context-specific mediators, broader mechanisms of change, effects, or theoretical frameworks.

As an illustration, consider a research team working to develop a school-based physical activity intervention for adolescents in a regional or remote Indigenous Australian community. Instead of transferring in or modifying an existing intervention (for example, a successful self-determination theory protocol from an inner city setting), researchers using a co-design approach would engage in extensive collaborative and shared learning activities to understand the complexities of the social, environmental, and cultural context impacting the focal community. The methods, procedures, and evaluation strategies that they subsequently employ could range from 'traditional' tools (e.g., interviews, focus groups), to more context- and population-specific approaches that are responsive to community members' own ways of knowing, doing, and being (e.g., storyboards or scenarios; Grindell et al., 2022; Slattery et al., 2020). A resultant multi-component, community-led intervention may be designed using (for example) principles of connection to the land and community, and would offer insight into context-specific meaning regarding identity and interpersonal connection. Greater use of such approaches would enrich our appreciation of population, community, spiritual, and cultural factors. Indeed, by pursuing such an approach our theories would develop, our methods would be more diverse and tailored, and our research impact (potentially) more meaningful. And, although our hypothetical example is pertinent in Australia, there are many other countries where similar principles may be brought to work with other First Nations peoples (e.g., Canada, New Zealand, Norway), and countless more settings where other diverse (e.g., migrant, refugee, disability) populations deserve targeted and considered attention (for a real-world illustration of how WEIRD conceptualisations of health do not necessarily translate across contexts, see Kingsley et al., 2009). In sum, by incorporating collaborative, participatory principles, and more explicitly focusing on marginalised, under-researched (non-WEIRD) populations (and better considering their perspectives), we will begin to better address our obligation for a more equitable science of physical activity behaviour change for *all* individuals in *diverse* contexts.

2.4. 'Thinking fast': better understanding and measuring automatic processes

Dual-process models represent the most significant recent expansion in terms of theoretical approaches to the study of physical activity behaviour change and maintenance (Rhodes, McEwan, & Rebar, 2019). Despite growing interest, though, these approaches remain under-utilised/researched compared to more traditional perspectives (i.e., those emphasising reflective, deliberate processes; Brand & Ekkekakis, 2021). As a result, there remains substantial scope to better understand and investigate automatic, non-conscious processes in physical activity behaviour change research. Revisiting our earlier point regarding the adoption of dynamic theories, we consider it important that we progress our understanding of how automatic processes impact reflective processes, how those processes independently and collectively impact behaviour, and in turn, how behaviour impacts automatic (and reflective) processes. Browning and colleagues (2024), for instance, recently reported that affective judgements (reflective, conscious affect toward physical activity) more strongly predicted physical activity behaviours when they were congruent with automatic affective evaluations (rapid affective response to a stimulus; often labelled 'implicit attitudes'). That is, when one's automatic affective evaluations *and* their affective judgements are positive, their affective judgements strongly predict increased engagement in physical activity behaviour. If this is not the case (e.g., if automatic evaluations are negative or ambivalent while reflective judgements are strongly positive), one has to draw upon cognitive resources (e.g., conscious contemplation of benefits of physical activity) to overcome their automatic response; thus, decreasing their likelihood of engaging in physical activity. Discoveries like these, grounded in contemporary dual-process theories (e.g., Affective-Reflective Theory; Brand & Ekkekakis, 2018), inform how we might intervene to modify automatic processes and change physical activity behaviour. Accordingly, interventions that target both automatic affective evaluations (e.g., through evaluative conditioning; see Moran et al., 2023) and affective judgements (see Rhodes, Gray, & Husband, 2019) may be more effective for physical activity behaviour change than those that only target one of those constructs (Browning et al., 2024).

The measurement of non-conscious processes has also been the subject of ongoing debate. Typically, automatic processes such as affective evaluations are assessed in contemporary studies through implicit measurement tools (hereafter, referred to as 'implicit measures') that require participants to quickly respond to stimuli, ostensibly revealing non-conscious associations with or attitudes toward an implicit psychological process that is inferred through response time(s) (Chevance et al., 2019; Znanewitz et al., 2018). The use of implicit measures gained traction due to (a) the purported advantages over self-report measures (e.g., resistance to social desirability biases, more suitable access to 'unconscious' thoughts; Corneille & Gawronski, 2024), and (b) the incompatibility of using self-report approaches to measure certain implicit processes (e.g., habit; see Hagger, 2019). However, implicit measures have also been questioned in terms of their reliability evidence, intercorrelations with data derived from other tools, and susceptibility to contextual influences (Zenko & Ekkekakis, 2019). In fact, there is recent evidence that implicit measures are also prone to biases (social desirability and others) and may not in fact be superior to self-reports for measuring unconscious thoughts and feelings (see Corneille & Gawronski, 2024, for a critical overview). There has also been recent attention on broader potential ethical issues related to measuring automatic process to then target people's behaviours *through* these processes (Kuyer & Gordijn, 2023). In addressing issues on their assessment, we are not advocating for the exclusive use of any one type of automatic process measurement. Instead, echoing recent calls for advancing measurement of automatic processes in our field (e.g., Rhodes, McEwan, & Rebar, 2019; Zenko & Ekkekakis, 2019), we recommend that researchers conduct rigorous psychometric testing, improve reporting of their rationale for using a measurement tool, and be judicious with their selection of implicit measures (e.g., see Corneille & Gawronski, 2024; Watson et al., 2022).

Given the developing nature of this field, it is important also to monitor advancements in novel dual-process approaches. Recent work on the Theory of Effort Minimisation in Physical Activity, for example, is based on the notion that one's automatic tendency toward behaviour that minimises energy usage (e.g., sedentary behaviour) may explain why people who often intend to be physically active, are not (Cheval & Boisgontier, 2021; Cheval et al., 2024; Parma et al., 2023). Cheval and colleagues (2018) propose that physical activity and sedentary behaviours exist on a continuum (rather than being considered as two distinct constructs), and that physical activity behaviour may result from competing forces along that continuum. To overcome the attraction toward a sedentary behaviour (e.g., being given the opportunity to sit down), a greater degree of inhibitory control is required (Cheval et al., 2020). The Theory of Effort Minimisation in Physical Activity is another addition to our suite of theoretical frameworks, and may also inform behaviour change interventions. For example, an intervention designed to reduce perceived effort while exercising may improve affective associations with exercise, reducing the executive function (i.e., inhibitory control) required to overcome the effort minimisation attraction (Cheval et al., 2024). However, further empirical investigation of these assumptions—in addition to the measurement challenges and

dynamicity described above in relation to dual-process theories—is required.

3. Conclusions

In the 25 years since the first volume of *Psychology of Sport and Exercise*, efforts to understand and improve health and physical activity behaviours have grown rapidly. The diversity we now see in approaches to studying physical activity behaviour—from social cognitive models through to dual-process approaches and detailed practical taxonomies—has significantly improved our understanding and practice of behaviour change. There remain, however, critical gaps and key opportunities that warrant further attention. We highlighted four such 'calls to action' for physical activity behaviour change research. Our selection was and is far from exhaustive, but represents avenues that we believe are priorities for the next generation of physical activity behaviour change research and practice. We provided considerations that encompass theoretical refinement, reflective and automatic processes, co-design principles, contemporary trial design and research methods, and technological innovations that may allow us to better target behaviour change *and* maintenance. The last 25 years of research in this field has built a compelling platform for the study of behaviour change—the next 25 provide an opportunity to drive meaningful advancements that improve health equity and outcomes.

CRediT authorship contribution statement

Aaron Simpson: Writing – review & editing, Writing – original draft, Conceptualization. **Mark R. Beauchamp:** Writing – review & editing, Conceptualization. **James Dimmock:** Writing – review & editing, Conceptualization. **Claire Willis:** Writing – review & editing, Conceptualization. **Ben Jackson:** Writing – review & editing, Writing – original draft, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

Authors AS, CW and BJ were supported by funding from Healthway as part of ongoing work to contribute to the evidence base for health promotion programs related to Healthway's priority health areas.

Data availability

No data was used for the research described in the article.

References

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. *Health Psychology, 27*(3), 379–387. https://doi.org/10.1037/0278-6133.27.3.379

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211.

Ajzen, I. (2015). The theory of planned behaviour is alive and well, and not ready to retire: A commentary on sniehotta, Presseau, and Araújo-Soares. *Health Psychology Review, 9*(2), 131–137. https://doi.org/10.1080/17437199.2014.883474

Ajzen, I. (2020). The theory of planned behavior: Frequently asked questions. *Human Behavior and Emerging Technologies, 2*(4), 314–324.

Alcántara, C., Diaz, S. V., Cosenzo, L. G., Loucks, E. B., Penedo, F. J., & Williams, N. J. (2020). Social determinants as moderators of the effectiveness of health behavior change interventions: Scientific gaps and opportunities. *Health Psychology Review, 14*(1), 132–144. https://doi.org/10.1080/17437199.2020.1718527

Angus, D. C., Alexander, B. M., Berry, S., Buxton, M., Lewis, R., Paoloni, M., Webb, S. A. R., Arnold, S., Barker, A., Berry, D. A., Bonten, M. J. M., Brophy, M., Butler, C., Cloughesy, T. F., Derde, L. P. G., Esserman, L. J., Ferguson, R., Fiore, L., Gaffey, S. C., … Woodcock, J. (2019). Adaptive platform trials: Definition, design, conduct and reporting considerations. *Nature Reviews Drug Discovery, 18*, 797–807. https://doi.org/10.1038/s41573-019-0034-3

Apicella, C., Norenzayan, A., & Henrich, J. (2020). Beyond WEIRD: A review of the last decade and a look ahead to the global laboratory of the future. *Evolution and Human Behavior, 41*(5), 319–329. https://doi.org/10.1016/j.evolhumbehav.2020.07.015

Armitage, C. J., & Conner, M. (2000). Social cognition models and health behaviour: A structured review. *Psychology and Health, 15*(2), 173–189. https://doi.org/10.1080/08870440008400299

Asparouhov, T., Hamaker, E. L., & Muthén, B. (2018). Dynamic structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal, 25*(3), 359–388. https://doi.org/10.1080/10705511.2017.1406803

Atkins, L., Francis, J., Islam, R., O'Connor, D., Patey, A., Ivers, N., Foy, R., Duncan, E. M., Colquhoun, H., Grimshaw, J. M., Lawton, R., & Michie, S. (2017). A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implementation Science, 12*, 77. https://doi.org/10.1186/s13012-017-0605-9

Aunger, R., & Curtis, V. (2016). Behaviour centred design: Towards an applied science of behaviour change. *Health Psychology Review, 10*(4), 425–446. https://doi.org/10.1080/17437199.2016.1219673

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall, Inc.

Barr, S., Gilg, A., & Shaw, G. (2011). 'Helping people make better choices': Exploring the behaviour change agenda for environmental sustainability. *Applied Geography, 31*(2), 712–720. https://doi.org/10.1016/j.apgeog.2010.12.003

Barrera, M., Jr., Castro, F. G., Strycker, L. A., & Toobert, D. J. (2013). Cultural adaptations of behavioral health interventions: A progress report. *Journal of Consulting and Clinical Psychology, 81*(2), 196–205. https://doi.org/10.1037/a0027085

Bauman, A. E., Reis, R. S., Sallis, J. F., Wells, J. C., Loos, R. J., & Martin, B. W. (2012). Correlates of physical activity: Why are some people physically active and others not? *The Lancet, 380*(9838), 258–271. https://doi.org/10.1016/S0140-6736(12)60735-1

Beauchamp, M. R., Crawford, K. L., & Jackson, B. (2019). Social cognitive theory and physical activity: Mechanisms of behavior change, critique, and legacy. *Psychology of Sport and Exercise, 42*, 110–117. https://doi.org/10.1016/j.psychsport.2018.11.009

Biddle, S. J., Gorely, T., Faulkner, G., & Mutrie, N. (2023). Psychology of physical activity: A 30-year reflection on correlates, barriers, and theory. *International Journal of Sport and Exercise Psychology, 21*(1), 1–14. https://doi.org/10.1080/1612197X.2022.2147261

Blackwell, S. E., Schönbrodt, F. D., Woud, M. L., Wannemüller, A., Bektas, B., Braun Rodrigues, M., Hirdes, J., Stumpp, M., & Margraf, J. (2023). Demonstration of a 'leapfrog' randomized controlled trial as a method to accelerate the development and optimization of psychological interventions. *Psychological Medicine, 53*(13), 6113–6123. https://doi.org/10.1017/S0033291722003294

Brand, R., & Ekkekakis, P. (2018). Affective–reflective theory of physical inactivity and exercise. *German Journal of Exercise and Sport Research, 48*(1), 48–58. https://doi.org/10.1007/s12662-017-0477-9

Brand, R., & Ekkekakis, P. (2021). Exercise behavior change revisited: Affective-reflective theory. In Z. Zenko, & L. Jones (Eds.), *Essentials of exercise and sport psychology: An open access textbook* (pp. 62–92). Society for Transparency, Openness, and Replication in Kinesiology. https://doi.org/10.51224/B1004.

Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist, 32*(7), 513–531. https://psycnet.apa.org/doi/10.1037/0003-066X.32.7.513.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Harvard University Press.

Browning, N. G., Phipps, D. J., Rhodes, R. E., & Hamilton, K. (2024). Testing the moderative role of automatic-reflective affect divergence in predicting physical activity. *Psychology of Sport and Exercise, 71*, Article 102538. https://doi.org/10.1016/j.psychsport.2023.102538

Camiré, M. (2023). Proposing an ontological shift from intervention to intravention in sport and exercise psychology. *Psychology of Sport and Exercise, 64*, Article 102342. https://doi.org/10.1016/j.psychsport.2022.102342

Cane, J., O'Connor, D., & Michie, S. (2012). Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implementation Science, 7*, 37. https://doi.org/10.1186/1748-5908-7-37

Carey, R. N., Connell, L. E., Johnston, M., Rothman, A. J., De Bruin, M., Kelly, M. P., & Michie, S. (2019). Behavior change techniques and their mechanisms of action: A synthesis of links described in published intervention literature. *Annals of Behavioral Medicine, 53*(8), 693–707. https://doi.org/10.1093/abm/kay078

Chalabaev, A., Cheval, B., Maltagliati, S., Saoudi, I., & Sniehotta, F. F. (2023). Beyond individual cognitions: Time for intervention science to focus on health context and audience. *Journal of Physical Activity and Health, 20*(6), 465–470. https://doi.org/10.1123/jpah.2023-0072

Cheval, B., & Boisgontier, M. P. (2021). The theory of effort minimization in physical activity. *Exercise and Sport Sciences Reviews, 49*(3), 168–178. https://doi.org/10.1249/JES.0000000000000252

Cheval, B., Daou, M., Cabral, D. A., Bacelar, M. F., Parma, J. O., Forestier, C., Orsholits, D., Sander, D., Boisgontier, M. P., & Miller, M. W. (2020). Higher inhibitory control is required to escape the innate attraction to effort minimization. *Psychology of Sport and Exercise, 51*, Article 101781. https://doi.org/10.1016/j.psychsport.2020.101781

Cheval, B., Tipura, E., Burra, N., Frossard, J., Chanal, J., Orsholits, D., Radel, R., & Boisgontier, M. P. (2018). Avoiding sedentary behaviors requires more cortical resources than avoiding physical activity: An EEG study. *Neuropsychologia, 119*, 68–80. https://doi.org/10.1016/j.neuropsychologia.2018.07.029

Cheval, B., Zou, L., Maltagliati, S., Fessler, L., Owen, N., Falck, R. S., Yu, Q., Zhang, Z., & Dupuy, O. (2024). Intention–behaviour gap in physical activity: Unravelling the critical role of the automatic tendency towards effort minimisation. *British Journal of Sports Medicine, 58*, 889–891. https://doi.org/10.1136/bjsports-2024-108144

Chevance, G., Bernard, P., Chamberland, P. E., & Rebar, A. (2019). The association between implicit attitudes toward physical activity and physical activity behaviour: A systematic review and correlational meta-analysis. *Health Psychology Review, 13* (3), 248–276. https://doi.org/10.1080/17437199.2019.1618726

Clancy, K. B., & Davis, J. L. (2019). Soylent is people, and WEIRD is white: Biological anthropology, whiteness, and the limits of the WEIRD. *Annual Review of Anthropology, 48*, 169–186. https://doi.org/10.1146/annurev-anthro-102218-011133

Conner, M. T., & Norman, P. (2015). Predicting and changing health behaviour: A social cognition approach. In M. T. Conner, & P. Norman (Eds.), *Predicting and changing health behaviour: Research and practice with social cognition models* (3rd ed., pp. 1–29). Open University Press.

Constantin, N., Edward, H., Ng, H., Radisic, A., Yule, A., D'Asti, A., D'Amore, C., Reid, J. C., & Beauchamp, M. (2022). The use of co-design in developing physical activity interventions for older adults: A scoping review. *BMC Geriatrics, 22*(1), 647. https://doi.org/10.1186/s12877-022-03345-4

Corneille, O., & Gawronski, B. (2024). Self-reports are better measurement instruments than implicit measures. *Nature Reviews Psychology, 3*, 835–846. https://doi.org/10.1038/s44159-024-00376-z

Costa Santos, A., Willumsen, J., Meheus, F., Ilbawi, A., & Bull, F. C. (2023). The cost of inaction on physical inactivity to public health-care systems: A population-attributable fraction analysis. *Lancet Global Health, 11*(1), e32–e39. https://doi.org/10.1016/S2214-109X(22)00464-8

Courneya, K. S., & Bobick, T. M. (2000). Integrating the theory of planned behavior with the processes and stages of change in the exercise domain. *Psychology of Sport and Exercise, 1*(1), 41–56. https://doi.org/10.1016/S1469-0292(00)00006-6

Davis, R., Campbell, R., Hildon, Z., Hobbs, L., & Michie, S. (2015). Theories of behaviour and behaviour change across the social and behavioural sciences: A scoping review. *Health Psychology Review, 9*(3), 323–344. https://doi.org/10.1080/17437199.2014.941722

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum Press.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Dunton, G. F. (2017). Ecological momentary assessment in physical activity research. *Exercise and Sport Sciences Reviews, 45*(1), 48–54. https://doi.org/10.1249/JES.0000000000000092

Dunton, G. F., Leventhal, A. M., Rebar, A. L., Gardner, B., Intille, S. S., & Rothman, A. J. (2022). Towards consensus in conceptualizing and operationalizing physical activity maintenance. *Psychology of Sport and Exercise, 61*, Article 102214. https://doi.org/10.1016/j.psychsport.2022.102214

Ekezie, W., Connor, A., Gibson, E., Khunti, K., & Kamal, A. (2023). A systematic review of behaviour change techniques within interventions to increase vaccine uptake among ethnic minority populations. *Vaccines, 11*(7), 1259. https://doi.org/10.3390/vaccines11071259

Englert, C., & Taylor, I. M. (2021). Introduction to motivation and self-regulation in sport and exercise. In C. Englert, & I. M. Taylor (Eds.), *Motivation and self-regulation in sport and exercise* (pp. 1–7). Taylor & Francis Group.

Etherington, N., Rodrigues, I. B., Giangregorio, L., Graham, I. D., Hoens, A. M., Kasperavicius, D., Kelly, C., Moore, J. E., Ponzano, M., Presseau, J., Sibley, K. M., & Straus, S. (2020). Applying an intersectionality lens to the theoretical domains framework: A tool for thinking about how intersecting social identities and structures of power influence behaviour. *BMC Medical Research Methodology, 20*, 169. https://doi.org/10.1186/s12874-020-01056-1

Evans, J. S. B., & Stanovich, K. E. (2013). Dual-process theories of higher cognition: Advancing the debate. *Perspectives on Psychological Science, 8*(3), 223–241. https://doi.org/10.1177/1745691612460685

Feil, K., Fritsch, J., & Rhodes, R. E. (2023). The intention-behaviour gap in physical activity: A systematic review and meta-analysis of the action control framework. *British Journal of Sports Medicine, 57*(19), 1265–1271. https://doi.org/10.1136/bjsports-2022-106640

Fischer, R., Bailey, Y., Shankar, M., Safaeinili, N., Karl, J., Daly, A., Johnson, F. N., Winter, T., Arahanga-Doyle, H., Fox, R., Abubakar, A., & Zulman, D. M. (2024). Cultural challenges for adapting behavioral intervention frameworks: A critical examination from a cultural psychology perspective. *Clinical Psychology Review*. , Article 102425.. https://doi.org/10.1016/j.cpr.2024.102425

Free, C., Phillips, G., Galli, L., Watson, L., Felix, L., Edwards, P., Patel, V., & Haines, A. (2013). The effectiveness of mobile-health technology-based health behaviour change or disease management interventions for health care consumers: A systematic review. *PLoS Medicine, 10*(1), Article e1001362. https://doi.org/10.1371/journal.pmed.1001362

Garcia, L. M., Diez Roux, A. V., Martins, A. C., Yang, Y., & Florindo, A. A. (2017). Development of a dynamic framework to explain population patterns of leisure-time physical activity through agent-based modeling. *International Journal of Behavioral Nutrition and Physical Activity, 14*, 111. https://doi.org/10.1186/s12966-017-0553-4

Gardner, B., Lally, P., & Rebar, A. L. (2020). Does habit weaken the relationship between intention and behaviour? Revisiting the habit-intention interaction hypothesis. *Social and Personality Psychology Compass, 14*(8), Article e12553. https://doi.org/10.1111/spc3.12553

Gardner, B., Rebar, A. L., de Wit, S., & Lally, P. (2024). What is habit and how can it be used to change real-world behaviour? Narrowing the theory-reality gap. *Social and Personality Psychology Compass, 18*(6), Article e12975. https://doi.org/10.1111/spc3.12975

Gold, S. M., Bofill Roig, M., Miranda, J. J., Pariante, C., Posch, M., & Otte, C. (2022). Platform trials and the future of evaluating therapeutic behavioural interventions. *Nature Reviews Psychology, 1*(1), 7–8. https://doi.org/10.1038/s44159-021-00012-0

Gorely, T., & Bruce, D. (2000). A 6-month investigation of exercise adoption from the contemplation stage of the transtheoretical model. *Psychology of Sport and Exercise, 1* (2), 89–101. https://doi.org/10.1016/S1469-0292(00)00012-1

Gourlan, M., Bernard, P., Bortolon, C., Romain, A. J., Lareyre, O., Carayol, M., Ninot, G., & Boiché, J. (2016). Efficacy of theory-based interventions to promote physical activity. A meta-analysis of randomised controlled trials. *Health Psychology Review, 10*(1), 50–66. https://doi.org/10.1080/17437199.2014.981777

Griessbach, A., Schönenberger, C. M., Heravi, A. T., Gloy, V., Agarwal, A., Hallenberger, T. J., Schandelmaier, S., Janiaud, P., Amstutz, A., Covino, M., Mall, D., Speich, B., & Briel, M. (2024). Characteristics, progression, and output of randomized platform trials: A systematic review. *JAMA Network Open, 7*(3), Article e243109. https://doi.org/10.1001/jamanetworkopen.2024.3109

Grindell, C., Coates, E., Croot, L., & O'Cathain, A. (2022). The use of co-production, co-design and co-creation to mobilise knowledge in the management of health conditions: A systematic review. *BMC Health Services Research, 22*(1), 877. https://doi.org/10.1186/s12913-022-08079-y

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: A pooled analysis of 358 population-based surveys with 1.9 million participants. *Lancet Global Health, 6*(10), e1077–e1086. https://doi.org/10.1016/S2214-109X(18)30357-7

Hagger, M. S. (2019). Habit and physical activity: Theoretical advances, practical implications, and agenda for future research. *Psychology of Sport and Exercise, 42*, 118–129. https://doi.org/10.1016/j.psychsport.2018.12.007

Hagger, M. S. (2025). Psychological determinants of health behavior. *Annual Review of Psychology, 76*, 821–850. https://doi.org/10.1146/annurev-psych-020124-114222

Hagger, M. S., Hamilton, K., Phipps, D. J., Protogerou, C., Zhang, C. Q., Girelli, L., Mallia, L., & Lucidi, F. (2023). Effects of habit and intention on behavior: Meta-analysis and test of key moderators. *Motivation Science, 9*(2), 73–94. https://doi.org/10.1037/mot0000294

Hagger, M. S., Hankonen, N., Chatzisarantis, N. L., & Ryan, R. M. (2020). Changing behavior using self-determination theory. In M. S. Hagger, L. D. Cameron, K. Hamilton, N. Hankonen, & T. Lintunen (Eds.), *The handbook of behavior change* (pp. 104–119). Cambridge University Press. https://doi.org/10.1017/9781108677318.

Hagger, M. S., Moyers, S., McAnally, K., & McKinley, L. E. (2020). Known knowns and known unknowns on behavior change interventions and mechanisms of action. *Health Psychology Review, 14*(1), 199–212. https://doi.org/10.1080/17437199.2020.1719184

Harari, G. M., & Gosling, S. D. (2023). Understanding behaviours in context using mobile sensing. *Nature Reviews Psychology, 2*(12), 767–779. https://doi.org/10.1038/s44159-023-00235-3

Hardeman, W., Houghton, J., Lane, K., Jones, A., & Naughton, F. (2019). A systematic review of just-in-time adaptive interventions (JITAIs) to promote physical activity. *International Journal of Behavioral Nutrition and Physical Activity, 16*, 31. https://doi.org/10.1186/s12966-019-0792-7

Hardeman, W., Johnston, M., Johnston, D., Bonetti, D., Wareham, N., & Kinmonth, A. L. (2002). Application of the theory of planned behaviour in behaviour change interventions: A systematic review. *Psychology and Health, 17*(2), 123–158. https://doi.org/10.1080/08870440290013644a

Hardwick, R. M., Forrence, A. D., Krakauer, J. W., & Haith, A. M. (2019). Time-dependent competition between goal-directed and habitual response preparation. *Nature Human Behaviour, 3*(12), 1252–1262. https://doi.org/10.1038/s41562-019-0725-0

Heard, E., Fitzgerald, L., Wigginton, B., & Mutch, A. (2020). Applying intersectionality theory in health promotion research and practice. *Health Promotion International, 35* (4), 866–876. https://doi.org/10.1093/heapro/daz080

Heino, M. T., Knittle, K., Noone, C., Hasselman, F., & Hankonen, N. (2021). Studying behaviour change mechanisms under complexity. *Behavioral Sciences, 11*(5), 77. https://doi.org/10.3390/bs11050077

Hennessy, E. A., Johnson, B. T., Acabchuk, R. L., McCloskey, K., & Stewart-James, J. (2020). Self-regulation mechanisms in health behavior change: A systematic meta-review of meta-analyses, 2006–2017. *Health Psychology Review, 14*(1), 6–42. https://doi.org/10.1080/17437199.2019.1679654

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences, 33*, 61–83. https://doi.org/10.1017/s0140525x0999152x

Hofmann, S. G., Curtiss, J. E., & Hayes, S. C. (2020). Beyond linear mediation: Toward a dynamic network approach to study treatment processes. *Clinical Psychology Review, 76*, Article 101824. https://doi.org/10.1016/j.cpr.2020.101824

Houlihan, S. (2018). Dual-process models of health-related behaviour and cognition: A review of theory. *Public Health, 156*, 52–59. https://doi.org/10.1016/j.puhe.2017.11.002

Howlett, N., García-Iglesias, J., Bontoft, C., Breslin, G., Bartington, S., Freethy, I., Huerga-Malillos, M., Jones, J., Lloyd, N., Marshall, T., Williams, S., Wills, W., & Brown, K. (2022). A systematic review and behaviour change technique analysis of remotely delivered alcohol and/or substance misuse interventions for adults. *Drug and Alcohol Dependence, 239*, Article 109597. https://doi.org/10.1016/j.drugalcdep.2022.109597

Iida, M., Shrout, P. E., Laurenceau, J.-P., & Bolger, N. (2023). Using intensive longitudinal methods in psychological research. In H. Cooper, M. N. Coutanche, L. M. McMullen, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of*

research methods in psychology: Foundations, planning, measures, and psychometrics (2nd ed., pp. 327–359). American Psychological Association. https://doi.org/10.1037/0000318-016.

Johnson, B. T., & Acabchuk, R. L. (2018). What are the keys to a longer, happier life? Answers from five decades of health psychology research. *Social Science & Medicine, 196*, 218–226. https://doi.org/10.1016/j.socscimed.2017.11.001

Kahneman, D. (2011). *Thinking fast and slow*. Penguin.

Khan, N., Keck, L., Sykes, C., Rowden, C., Simister, J., Fenlon, S., McCallum, E., Bell, M., Whiting, D., Shelton, C., Wells, G., Giles, R., Howard, J., & Peckham, S. (2024). Diversity, community engagement and co-design in research: A rapid review. *BMJ Leader*. https://doi.org/10.1136/leader-2024-001046. Advance online publication.

Kidwell, K. M., & Almirall, D. (2023). Sequential, multiple assignment, randomized trial designs. *JAMA, 329*(4), 336–337. https://doi.org/10.1001/jama.2022.24324

Kilfoy, A., Hsu, T. C. C., Stockton-Powdrell, C., Whelan, P., Chu, C. H., & Jibb, L. (2024). An umbrella review on how digital health intervention co-design is conducted and described. *npj Digital Medicine, 7*(1), 374. https://doi.org/10.1038/s41746-024-01385-1

Kingsley, J. Y., Townsend, M., Phillips, R., & Aldous, D. (2009). "If the land is healthy it makes the people healthy": The relationship between caring for Country and health for the Yorta Yorta Nation, Boonwurrung and Bangerang Tribes. *Health & Place, 15*(1), 291–299. https://doi.org/10.1016/j.healthplace.2008.05.009

Koenig, F., Spiertz, C., Millar, D., Rodríguez-Navarro, S., Machín, N., Van Dessel, A., Genescà, J., Pericàs, J. M., & Posch, M. (2024). Current state-of-the-art and gaps in platform trials: 10 things you should know, insights from EU-PEARL. *eClinicalMedicine, 67*, Article 102384. https://doi.org/10.1016/j.eclinm.2023.102384

Kuhail, M. A., Alturki, N., Thomas, J., Alkhalifa, A. K., & Alshardan, A. (2024). Human-human vs human-AI therapy: An empirical study. *International Journal of Human-Computer Interaction*. https://doi.org/10.1080/10447318.2024.2385001. Advance online publication.

Kuyer, P., & Gordijn, B. (2023). Nudge in perspective: A systematic literature review on the ethical issues with nudging. *Rationality and Society, 35*(2), 191–230. https://doi.org/10.1177/10434631231155005

Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehotta, F. (2016). Theoretical explanations for maintenance of behaviour change: A systematic review of behaviour theories. *Health Psychology Review, 10*(3), 277–296. https://doi.org/10.1080/17437199.2016.1151372

Leggett, W. (2014). The politics of behaviour change: Nudge, neoliberalism and the state. *Policy & Politics, 42*(1), 3–19. https://doi.org/10.1332/030557312X655576

Li, Y., Schinke, R. J., Zhang, L., Ge, Y., Giffin, C. E., Steadman, E. A., Yang, X., Fink, C., Coholic, D., & Kpazai, G. (2025). Understanding the meta-transition experiences of Chinese table tennis athletes during the transition to first level teams: Group reflective practice interviews. *Psychology of Sport and Exercise.* , Article 102874.. https://doi.org/10.1016/j.psychsport.2025.102874

Marcus, B. H., Forsyth, L. H., Stone, E. J., Dubbert, P. M., McKenzie, T. L., Dunn, A. L., & Blair, S. N. (2000). Physical activity behavior change: Issues in adoption and maintenance. *Health Psychology, 19*(1S), 32–41. https://doi.org/10.1037/0278-6133.19.suppl1.32

Marks, L., Laird, Y., Trevena, H., Smith, B. J., & Rowbotham, S. (2022). A scoping review of citizen science approaches in chronic disease prevention. *Frontiers in Public Health, 10*, Article 743348. https://doi.org/10.3389/fpubh.2022.743348

Marques, M. M., Wright, A. J., Corker, E., Johnston, M., West, R., Hastings, J., Zhang, L., & Michie, S. (2024). The behaviour change technique ontology: Transforming the behaviour change technique taxonomy v1. *Wellcome Open Research, 8*, 308. https://doi.org/10.12688/wellcomeopenres.19363.2

Mather, M., Pettigrew, L. M., & Navaratnam, S. (2022). Barriers and facilitators to clinical behaviour change by primary care practitioners: A theory-informed systematic review of reviews using the theoretical domains framework and behaviour change wheel. *Systematic Reviews, 11*(1), 180. https://doi.org/10.1186/s13643-022-02030-2

McEachan, R. R. C., Conner, M., Taylor, N. J., & Lawton, R. J. (2011). Prospective prediction of health-related behaviours with the theory of planned behaviour: A meta-analysis. *Health Psychology Review, 5*(2), 97–144. https://doi.org/10.1080/17437199.2010.521684

McEwan, D., Rhodes, R. E., & Beauchamp, M. R. (2022). What happens when the party is over?: Sustaining physical activity behaviors after intervention cessation. *Behavioral Medicine, 48*(1), 1–9. https://doi.org/10.1080/08964289.2020.1750335

McGannon, K. R., & Schinke, R. J. (2013). "My first choice is to work out at work; then I don't feel bad about my kids": A discursive psychological analysis of motherhood and physical activity participation. *Psychology of Sport and Exercise, 14*(2), 179–188. https://doi.org/10.1016/j.psychsport.2012.10.001

McGannon, K. R., & Smith, B. (2015). Centralizing culture in cultural sport psychology research: The potential of narrative inquiry and discursive psychology. *Psychology of Sport and Exercise, 17*, 79–87. https://doi.org/10.1016/j.psychsport.2014.07.010

Melnikoff, D. E., & Bargh, J. A. (2018). The mythical number two. *Trends in Cognitive Sciences, 22*(4), 280–293. https://doi.org/10.1016/j.tics.2018.02.001

Michie, S., Johnston, M., Rothman, A. J., de Bruin, M., Kelly, M. P., Carey, R. N., Bohlen, L. E. C., Groarke, H. N. K., Anderson, N. C., & Zink, S. (2021). Developing an evidence-based online method of linking behaviour change techniques and theoretical mechanisms of action: A multiple methods study. *Health Services and Delivery Research, 9*(1), 1–168. https://doi.org/10.3310/hsdr09010

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., Eccles, M. P., Cane, J., & Wood, C. E. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: Building an international consensus for the reporting of behavior change interventions. *Annals of Behavioral Medicine, 46*(1), 81–95. https://doi.org/10.1007/s12160-013-9486-6

Michie, S., Van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science, 6*, 42. https://doi.org/10.1186/1748-5908-6-42

Michie, S., West, R., Campbell, R., Brown, J., & Gainforth, H. (2014). *ABC of behaviour change theories*. London: Silverback Publishing.

Michie, S., Wood, C. E., Johnston, M., Abraham, C., Francis, J., & Hardeman, W. (2015). Behaviour change techniques: The development and evaluation of a taxonomic method for reporting and describing behaviour change interventions (a suite of five studies involving consensus methods, randomised controlled trials and analysis of qualitative data). *Health Technology Assessment, 19*(99), 1–188. https://doi.org/10.3310/hta19990

Moran, T., Nudler, Y., & Bar-Anan, Y. (2023). Evaluative conditioning: Past, present, and future. *Annual Review of Psychology, 74*(1), 245–269. https://doi.org/10.1146/annurev-psych-032420-031815

Mossman, L. H., Slemp, G. R., Lewis, K. J., Colla, R. H., & O'Halloran, P. (2024). Autonomy support in sport and exercise settings: A systematic review and meta-analysis. *International Review of Sport and Exercise Psychology, 17*(1), 540–563. https://doi.org/10.1080/1750984X.2022.2031252

Muranko, Z., Andrews, D., Chaer, I., & Newton, E. J. (2019). Circular economy and behaviour change: Using persuasive communication to encourage pro-circular behaviours towards the purchase of remanufactured refrigeration equipment. *Journal of Cleaner Production, 222*, 499–510. https://doi.org/10.1016/j.jclepro.2019.02.219

Murray, K. E., Ermias, A., Lung, A., Mohamed, A. S., Ellis, B. H., Linke, S., Kerr, J., Bowen, D. J., & Marcus, B. H. (2017). Culturally adapting a physical activity intervention for Somali women: The need for theory and innovation to promote equity. *Translational behavioral medicine, 7*(1), 6–15. https://doi.org/10.1007/s13142-016-0436-2

Nahum-Shani, I., Smith, S. N., Spring, B. J., Collins, L. M., Witkiewitz, K., Tewari, A., & Murphy, S. A. (2018). Just-in-time adaptive interventions (JITAIs) in mobile health: Key components and design principles for ongoing health behavior support. *Annals of Behavioral Medicine, 52*(6), 446–462. https://doi.org/10.1007/s12160-016-9830-8

Nielsen, L., Riddle, M., King, J. W., Aklin, W. M., Chen, W., Clark, D., Collier, E., Czajkowski, S., Esposito, L., Ferrer, R., Green, P., Hunter, C., Kehl, K., King, R., Onken, L., Simmons, J. M., Stoeckel, L., Stoney, C., Tully, L., & Weber, W. (2018). The NIH science of behavior change program: Transforming the science through a focus on mechanisms of change. *Behaviour Research and Therapy, 101*, 3–11. https://doi.org/10.1016/j.brat.2017.07.002

Ntoumanis, N., Ng, J. Y., Prestwich, A., Quested, E., Hancox, J. E., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Lonsdale, C., & Williams, G. C. (2021). A meta-analysis of self-determination theory-informed intervention studies in the health domain: Effects on motivation, health behavior, physical, and psychological health. *Health Psychology Review, 15*(2), 214–244. https://doi.org/10.1080/17437199.2020.1718529

Ogden, J. (2016). Celebrating variability and a call to limit systematisation: The example of the behaviour change technique taxonomy and the behaviour change wheel. *Health Psychology Review, 10*(3), 245–250. https://doi.org/10.1080/17437199.2016.1190291

Parkinson, J., David, P., & Rundle-Thiele, S. (2017). Self-efficacy or perceived behavioural control: Which influences consumers' physical activity and healthful eating behaviour maintenance? *Journal of Consumer Behaviour, 16*(5), 413–423. https://doi.org/10.1002/cb.1641

Perski, O., Keller, J., Kale, D., Asare, B. Y. A., Schneider, V., Powell, D., Naughton, F., ten Hoor, G., Verboon, P., & Kwasnicka, D. (2022). Understanding health behaviours in context: A systematic review and meta-analysis of ecological momentary assessment studies of five key health behaviours. *Health Psychology Review, 16*(4), 576–601. https://doi.org/10.1080/17437199.2022.2112258

Phillips, L. A., & Mullan, B. A. (2023). Ramifications of behavioural complexity for habit conceptualisation, promotion, and measurement. *Health Psychology Review, 17*(3), 402–415. https://doi.org/10.1080/17437199.2022.2060849

Porter, C. D., Groves, C. I., Huong, C., & Brown, D. M. (2024). Predicting physical activity behavior among university students using the multi-process action control framework. *Psychology of Sport and Exercise, 75*, Article 102716. https://doi.org/10.1016/j.psychsport.2024.102716

Rebar, A. L., Dimmock, J. A., Jackson, B., Rhodes, R. E., Kates, A., Starling, J., & Vandelanotte, C. (2016). A systematic review of the effects of non-conscious regulatory processes in physical activity. *Health Psychology Review, 10*(4), 395–407. https://doi.org/10.1080/17437199.2016.1183505

Rhodes, R. E. (2017). The evolving understanding of physical activity behavior: A multi-process action control approach. In A. J. Elliot (Ed.), *Advances in motivation science* (pp. 171–205). Elsevier. https://doi.org/10.1016/bs.adms.2016.11.001.

Rhodes, R. E. (2021). Multi-process action control in physical activity: A primer. *Frontiers in Psychology, 12*, Article 797484. https://doi.org/10.3389/fpsyg.2021.797484

Rhodes, R. E., Boudreau, P., Josefsson, K. W., & Ivarsson, A. (2021). Mediators of physical activity behaviour change interventions among adults: A systematic review and meta-analysis. *Health Psychology Review, 15*(2), 272–286. https://doi.org/10.1080/17437199.2019.1706614

Rhodes, R. E., & de Bruijn, G. J. (2013). How big is the physical activity intention–behaviour gap? A meta-analysis using the action control framework. *British Journal of Health Psychology, 18*(2), 296–309. https://doi.org/10.1111/bjhp.12032

Rhodes, R. E., Gray, S. M., & Husband, C. (2019). Experimental manipulation of affective judgments about physical activity: A systematic review and meta-analysis of adults. *Health Psychology Review, 13*(1), 18–34. https://doi.org/10.1080/17437199.2018.1530067

Rhodes, R. E., La, H., Quinlan, A., & Grant, S. (2021). Enacting physical activity intention: A multi-process action control approach. In C. Englert, & I. Taylor (Eds.), *Motivation and self-regulation in sport and exercise* (pp. 8–19). Routledge.

Rhodes, R. E., McEwan, D., & Rebar, A. L. (2019). Theories of physical activity behaviour change: A history and synthesis of approaches. *Psychology of Sport and Exercise, 42*, 100–109. https://doi.org/10.1016/j.psychsport.2018.11.010

Rhodes, R. E., & Nigg, C. R. (2011). Advancing physical activity theory: A review and future directions. *Exercise and Sport Sciences Reviews, 39*(3), 113–119. https://doi.org/10.1097/JES.0b013e31821b94c8

Rhodes, R. E., & Sui, W. (2021). Physical activity maintenance: A critical narrative review and directions for future research. *Frontiers in Psychology, 12*, Article 725671. https://doi.org/10.3389/fpsyg.2021.725671

Ruissen, G. R., Beauchamp, M. R., Puterman, E., Zumbo, B. D., Rhodes, R. E., Hives, B., Sharpe, B. M., Julio, V. H., Low, C., & Wright, A. G. C. (2022). Continuous-time modeling of the bidirectional relationship between incidental affect and physical activity. *Annals of Behavioral Medicine, 56*(12), 1284–1299. https://doi.org/10.1093/abm/kaac024

Ruissen, G. R., Zumbo, B. D., Rhodes, R. E., Puterman, E., & Beauchamp, M. R. (2022). Analysis of dynamic psychological processes to understand and promote physical activity behaviour using intensive longitudinal methods: A primer. *Health Psychology Review, 16*(4), 492–525. https://doi.org/10.1080/17437199.2021.1987953

Ryan, R. M. (2023). *The Oxford handbook of self-determination theory*. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780197600047.001.0001

Ryan, R. M., & Deci, E. L. (2019). Brick by brick: The origins, development, and future of self-determination theory. In A. J. Elliot (Ed.), *Advances in motivation science* (pp. 111–156). Elsevier.

Ryan, R. M., & Deci, E. L. (2024). Self-determination theory. In F. Maggino (Ed.), *Encyclopedia of quality of life and well-being research* (pp. 6229–6235). Cham: Springer. https://doi.org/10.1007/978-3-031-17299-1.

Ryan, R. M., Duineveld, J. J., Di Domenico, S. I., Ryan, W. S., Steward, B. A., & Bradshaw, E. L. (2022). We know this much is (meta-analytically) true: A meta-review of meta-analytic findings evaluating self-determination theory. *Psychological Bulletin, 148*(11–12), 813–842. https://doi.org/10.1037/bul0000385

Samdal, G. B., Eide, G. E., Barth, T., Williams, G., & Meland, E. (2017). Effective behaviour change techniques for physical activity and healthy eating in overweight and obese adults; systematic review and meta-regression analyses. *International Journal of Behavioral Nutrition and Physical Activity, 14*, 42. https://doi.org/10.1186/s12966-017-0494-y

Schenk, P. M., Wright, A. J., West, R., Hastings, J., Lorencatto, F., Moore, C., Hayes, E., Schneider, V., Howes, E., & Michie, S. (2024). An ontology of mechanisms of action in behaviour change interventions. *Wellcome Open Research, 8*, 337. https://doi.org/10.12688/wellcomeopenres.19489.2

Schmitz, K. H., Brown, J. C., Irwin, M. L., Robien, K., Scott, J. M., Berger, N. A., Caan, B., Cercek, A., Crane, T. E., Evans, S. R., Ligibel, J. A., Meyerhardt, J. A., Agurs-Collins, T., Basen-Engquist, K., Bea, J. W., Cai, S. F., Cartmel, B., Chinchilli, V. M., Demark-Wahnefried, W., … Perna, F. M. (2025). Exercise and nutrition to improve cancer treatment-related outcomes (ENICTO). *Journal of the National Cancer Institute, 117*(1), 9–19. https://doi.org/10.1093/jnci/djae177

Schwarzer, R. (2008). Modeling health behavior change: How to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology: International Review, 57*(1), 1–29. https://doi.org/10.1111/j.1464-0597.2007.00325.x

Sheeran, P., Klein, W. M., & Rothman, A. J. (2017). Health behavior change: Moving from observation to intervention. *Annual Review of Psychology, 68*(1), 573–600. https://doi.org/10.1146/annurev-psych-010416-044007

Sheeran, P., Wright, C. E., Avishai, A., Villegas, M. E., Lindemans, J. W., Klein, W. M. P., Rothman, A. J., Miles, E., & Ntoumanis, N. (2020). Self-determination theory interventions for health behavior change: Meta-analysis and meta-analytic structural equation modeling of randomized controlled trials. *Journal of Consulting and Clinical Psychology, 88*(8), 726–737. https://doi.org/10.1037/ccp0000501

Shoesmith, E., Huddlestone, L., Lorencatto, F., Shahab, L., Gilbody, S., & Ratschen, E. (2021). Supporting smoking cessation and preventing relapse following a stay in a smoke-free setting: A meta-analysis and investigation of effective behaviour change techniques. *Addiction, 116*(11), 2978–2994. https://doi.org/10.1111/add.15452

Shu, J., & Jin, W. (2023). Prioritizing non-communicable diseases in the post-pandemic era based on a comprehensive analysis of the GBD 2019 from 1990 to 2019. *Scientific Reports, 13*, Article 13325. https://doi.org/10.1038/s41598-023-40595-7

Slattery, P., Saeri, A. K., & Bragge, P. (2020). Research co-design in health: A rapid overview of reviews. *Health Research Policy and Systems, 18*, 17. https://doi.org/10.1186/s12961-020-0528-9

Smith, E. R., & DeCoster, J. (2000). Dual-process models in social and cognitive psychology: Conceptual integration and links to underlying memory systems. *Personality and Social Psychology Review, 4*(2), 108–131. https://doi.org/10.1207/S15327957PSPR0402_01

Smith, B., & Sparkes, A. C. (2009). Narrative analysis and sport and exercise psychology: Understanding lives in diverse ways. *Psychology of Sport and Exercise, 10*(2), 279–288. https://doi.org/10.1016/j.psychsport.2008.07.012

Sniehotta, F. F., Presseau, J., & Araújo-Soares, V. (2014). Time to retire the theory of planned behaviour. *Health Psychology Review, 8*(1), 1–7. https://doi.org/10.1080/17437199.2013.869710

Spruijt-Metz, D., & Nilsen, W. (2014). Dynamic models of behavior for just-in-time adaptive interventions. *IEEE Pervasive Computing, 13*(3), 13–17. https://doi.org/10.1109/MPRV.2014.46

Teixeira, P. J., Marques, M. M., Silva, M. N., Brunet, J., Duda, J. L., Haerens, L., La Guardia, J., Lindwall, M., Lonsdale, C., Markland, D., Michie, S., Moller, A. C., Ntoumanis, N., Patrick, H., Reeve, J., Ryan, R. M., Sebire, S. J., Standage, M., Vansteenkiste, M., … Hagger, M. S. (2020). A classification of motivation and behavior change techniques used in self-determination theory-based interventions in health contexts. *Motivation Science, 6*(4), 438–455. https://doi.org/10.1037/mot0000172

Uleman, J. F., Luijten, M., Abdo, W. F., Vyrastekova, J., Gerhardus, A., Runge, J., Rod, N. H., & Verhagen, M. (2024). Triangulation for causal loop diagrams: Constructing biopsychosocial models using group model building, literature review, and causal discovery. *Npj Complexity, 1*(1), 19. https://doi.org/10.1038/s44260-024-00017-9

Vandelanotte, C., Trost, S., Hodgetts, D., Imam, T., Rashid, M., To, Q. G., & Maher, C. (2023). Increasing physical activity using an just-in-time adaptive digital assistant supported by machine learning: A novel approach for hyper-personalised mHealth interventions. *Journal of Biomedical Informatics, 144*, Article 104435. https://doi.org/10.1016/j.jbi.2023.104435

Vansteenkiste, M., Soenens, B., & Ryan, R. M. (2023). Basic psychological needs theory: A conceptual and empirical review of key criteria. In R. M. Ryan (Ed.), *The Oxford handbook of self-determination theory* (pp. 84–123). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780197600047.013.5.

Walsh, D. A. B., & Foster, J. L. H. (2021). A call to action. A critical review of mental health related anti-stigma campaigns. *Frontiers in Public Health, 8*, Article 569539. https://doi.org/10.3389/fpubh.2020.569539

Wang, L., & Miller, L. C. (2020). Just-in-the-moment adaptive interventions (JITAI): A meta-analytical review. *Health Communication, 35*(12), 1531–1544. https://doi.org/10.1080/10410236.2019.1652388

Watson, P., O'Callaghan, C., Perkes, I., Bradfield, L., & Turner, K. (2022). Making habits measurable beyond what they are not: A focus on associative dual-process models. *Neuroscience & Biobehavioral Reviews, 142*, Article 104869. https://doi.org/10.1016/j.neubiorev.2022.104869

Wellings, K., Collumbien, M., Slaymaker, E., Singh, S., Hodges, Z., Patel, D., & Bajos, N. (2006). Sexual behaviour in context: A global perspective. *The Lancet, 368*(9548), 1706–1728. https://doi.org/10.1016/S0140-6736(06)69479-8

West, R., Michie, S., Rubin, G. J., & Amlôt, R. (2020). Applying principles of behaviour change to reduce SARS-CoV-2 transmission. *Nature Human Behaviour, 4*(5), 451–459. https://doi.org/10.1038/s41562-020-0887-9

Whatnall, M. C., Sharkey, T., Hutchesson, M. J., Haslam, R. L., Bezzina, A., Collins, C. E., & Ashton, L. M. (2021). Effectiveness of interventions and behaviour change techniques for improving physical activity in young adults: A systematic review and meta-analysis. *Journal of Sports Sciences, 39*(15), 1754–1771. https://doi.org/10.1080/02640414.2021.1898107

Whiston, A., Kidwell, K. M., O'Reilly, S., Walsh, C., Walsh, J. C., Glynn, L., Robinson, K., & Hayes, S. (2024). The use of sequential multiple assignment randomized trials (SMARTs) in physical activity interventions: A systematic review. *BMC Medical Research Methodology, 24*(1), 308. https://doi.org/10.1186/s12874-024-02439-4

Willms, A., Rush, J., Hofer, S., Rhodes, R. E., & Liu, S. (2024). Advancing physical activity research methods using real-time and adaptive technology: A scoping review of "no-code" mobile health app research tools. *Sport, Exercise, and Performance Psychology*. https://doi.org/10.1037/spy0000360. Advance online publication.

Wood, W., & Rünger, D. (2016). Psychology of habit. *Annual Review of Psychology, 67*(1), 289–314. https://doi.org/10.1146/annurev-psych-122414-033417

World Health Organization. (2022). Invisible numbers: The true extent of noncommunicable diseases and what to do about them. https://iris.who.int/bitstream/handle/10665/362800/9789240057661-eng.pdf.

Yang, F., Wang, C., Lindsey, M. A., & An, R. (2025). Use of artificial-intelligence-based chatbots to promote physical activity: A systematic review of interventions. *Kinesiology Review, 14*(1), 80–92. https://doi.org/10.1123/kr.2024-0081

Zenko, Z., & Ekkekakis, P. (2019). Critical review of measurement practices in the study of automatic associations of sedentary behavior, physical activity, and exercise. *Journal of Sport & Exercise Psychology, 41*(5), 271–288. https://doi.org/10.1123/jsep.2017-0349

Zhang, C. Q., Zhang, R., Schwarzer, R., & Hagger, M. S. (2019). A meta-analysis of the health action process approach. *Health Psychology, 38*(7), 623–637. https://doi.org/10.1037/hea0000728

Zhong, W., Luo, J., & Zhang, H. (2024). The therapeutic effectiveness of artificial intelligence-based chatbots in alleviation of depressive and anxiety symptoms in short-course treatments: A systematic review and meta-analysis. *Journal of Affective Disorders, 356*, 459–469. https://doi.org/10.1016/j.jad.2024.04.057

Znanewitz, J., Braun, L., Hensel, D., Altobelli, C. F., & Hattke, F. (2018). A critical comparison of selected implicit measurement methods. *Journal of Neuroscience, Psychology, and Economics, 11*(4), 249–266. https://doi.org/10.1037/npe0000086